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Evaluation of Transition to Updated Regional Q-geoid Model

RIGA TECHNICAL UNIVERSITY
— 155 —

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Aim and tasks:

The research aim is to evaluate the transition to the updated best regional q-geoid model.

The research objective is the following **tasks**:

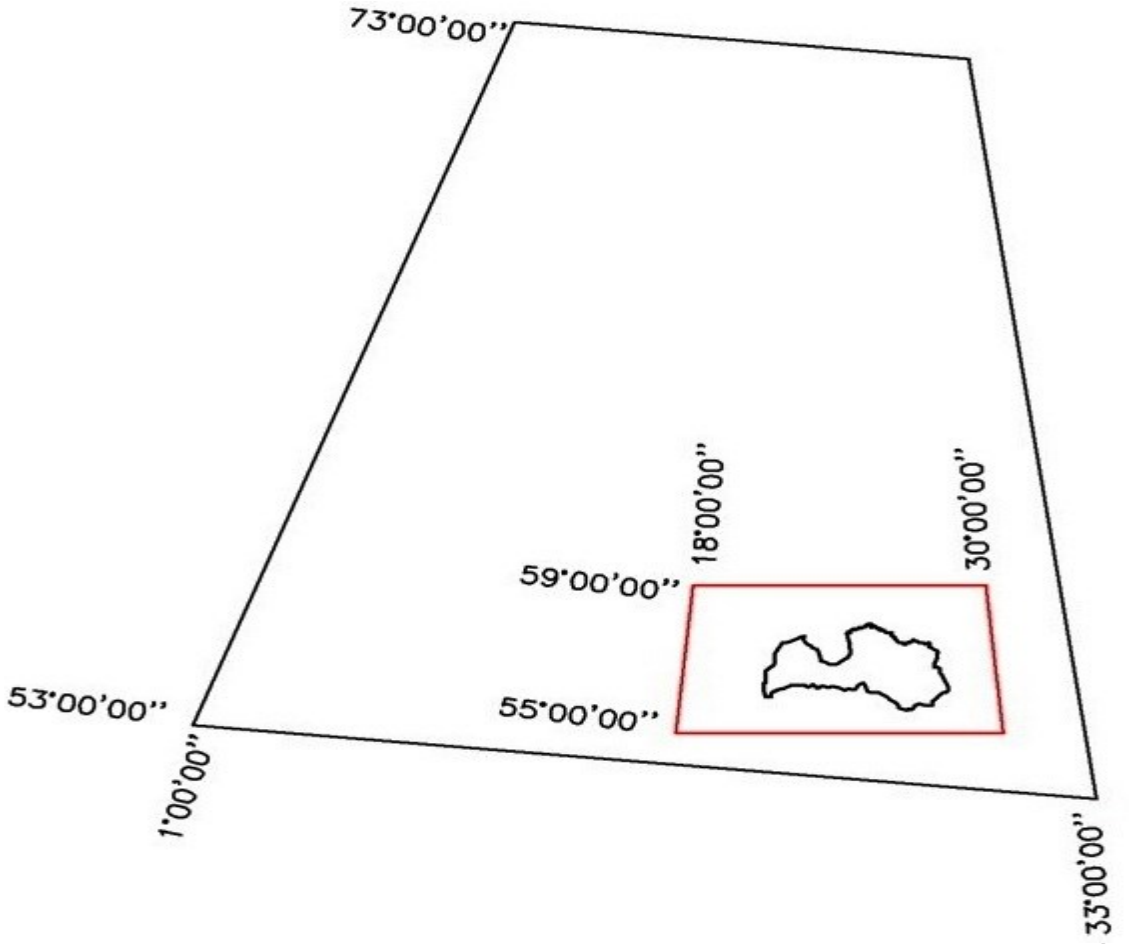
1) investigated and analysed the development of q-geoid model LV14 *(currently used)* ;

2) realized research of precision;

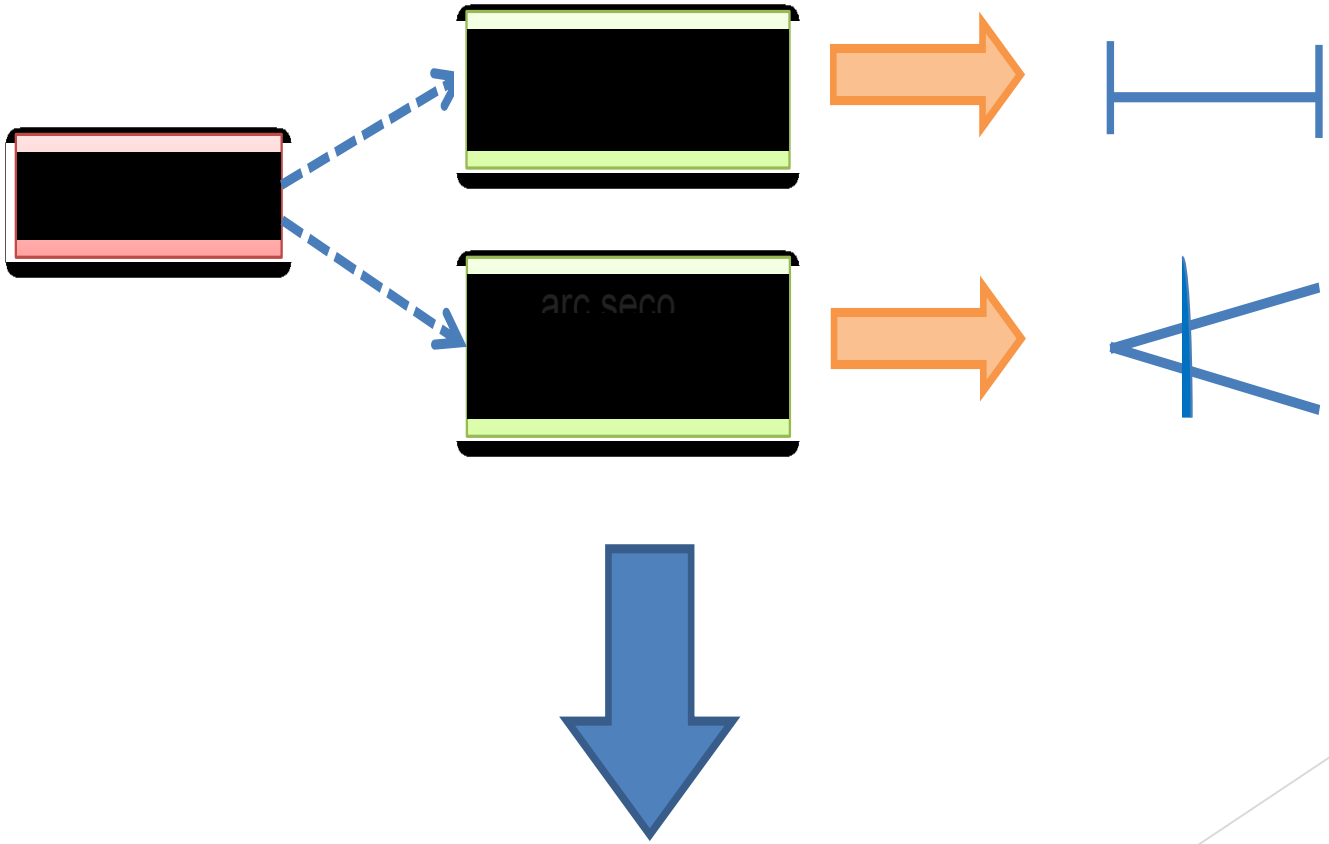
3) assesses the challenges of the European Vertical Reference System;

4) draw conclusions that allow further research in this area for development, innovation and improvement.

Main area of research



Accuracy of geomatics within the meaning



Accuracy of geomatics within the meaning

5mm
0,5 cm ≈ 1”

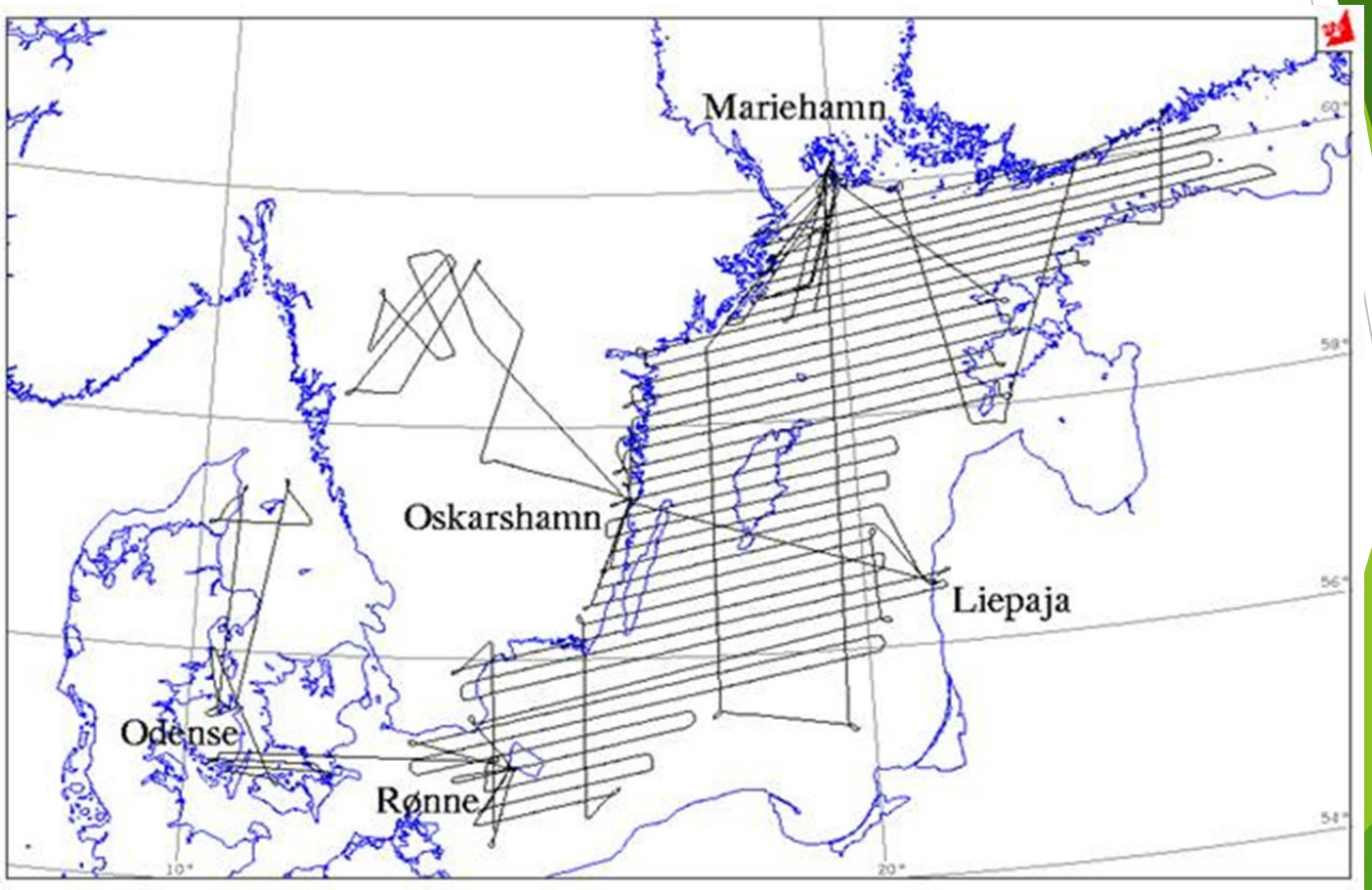
R= 1km

360^0/60’/60’’

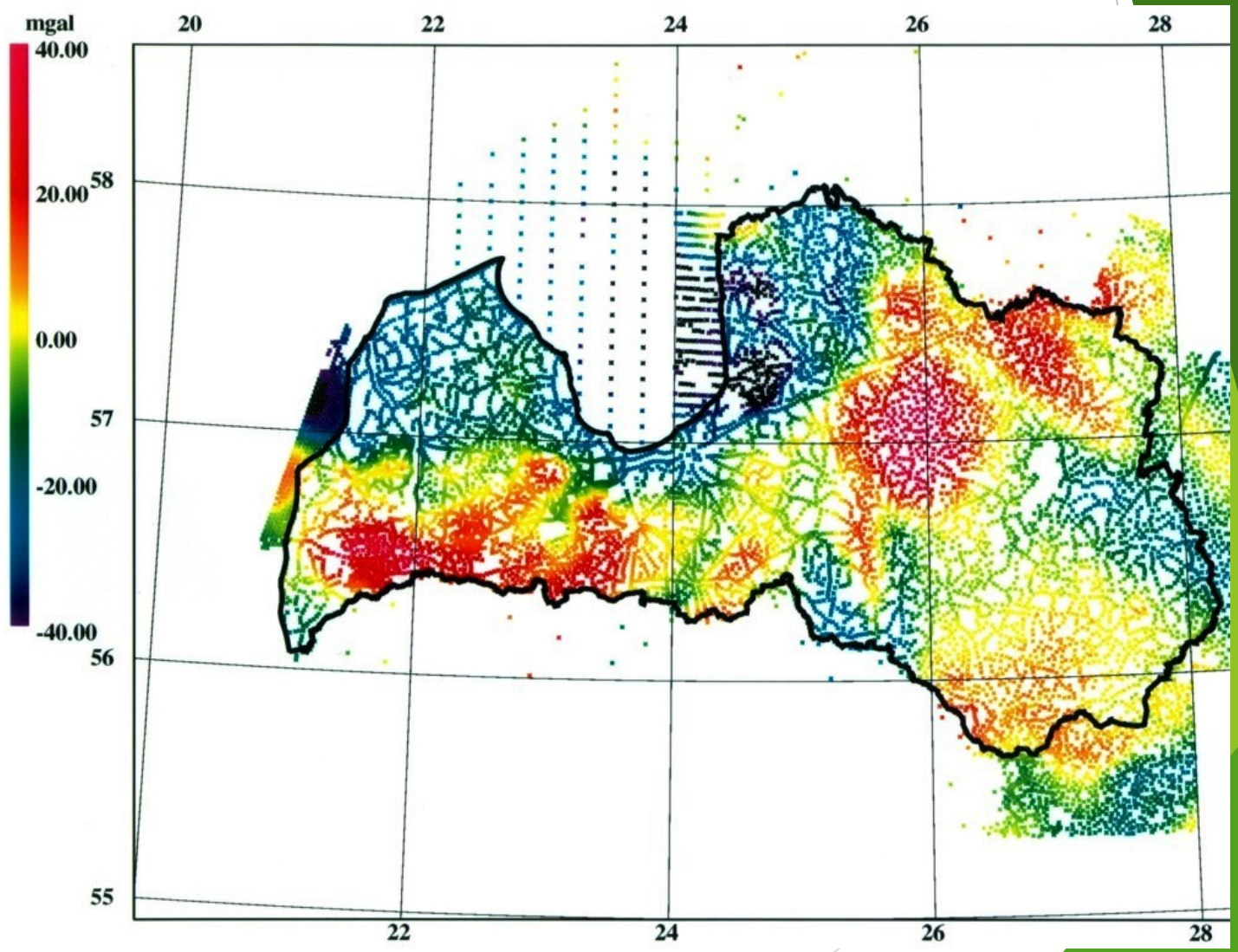
2πR **6,28km**

Good for deflection of vertical (**DoV**) observations and combining

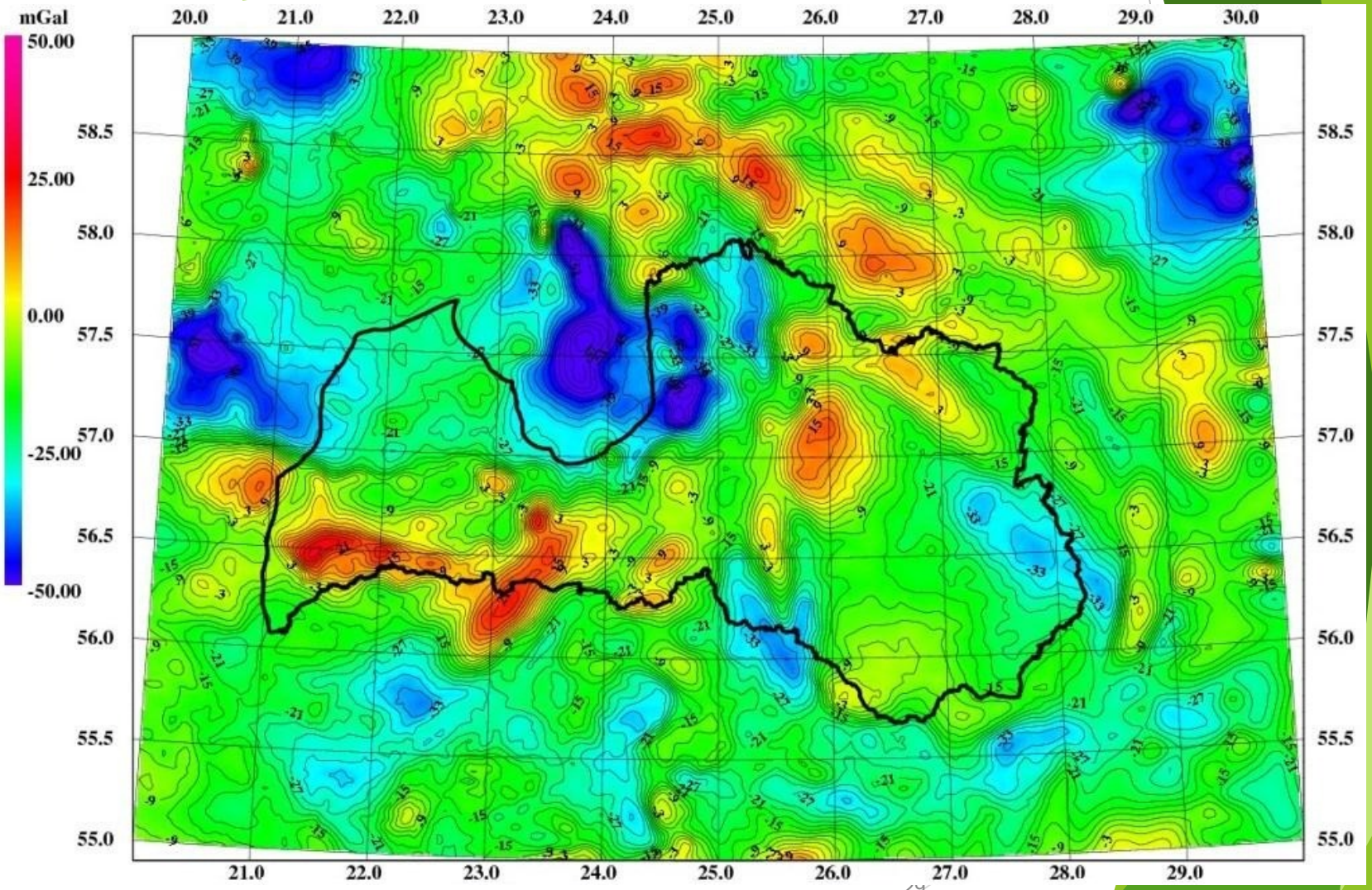
Aerogravimetric measurements over the Baltics within NKG



Free-air gravity anomalies and distribution of points

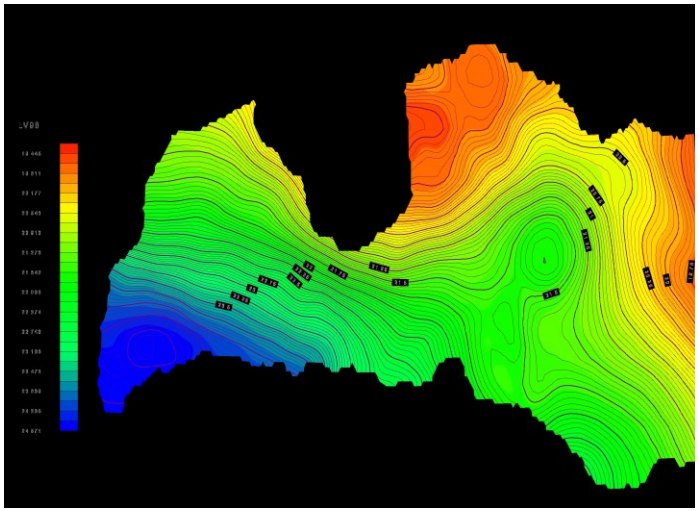


Gravity anomalies

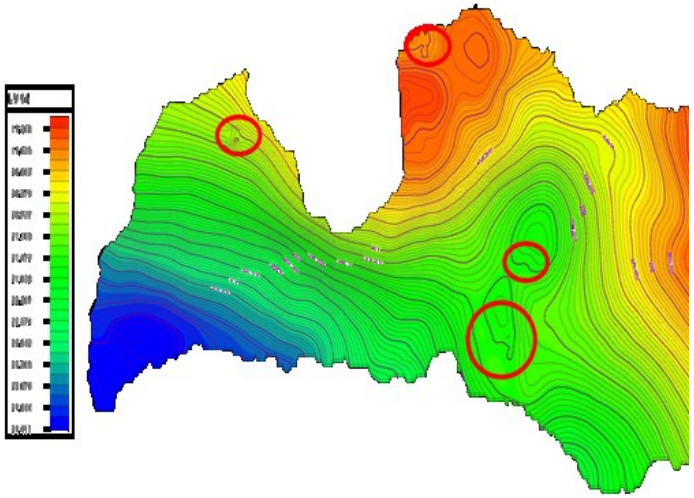


Bouguer anomalies ; C.I.: 3 mGal (2.67 g/cm**3)

Q- geoid model LV14 development process

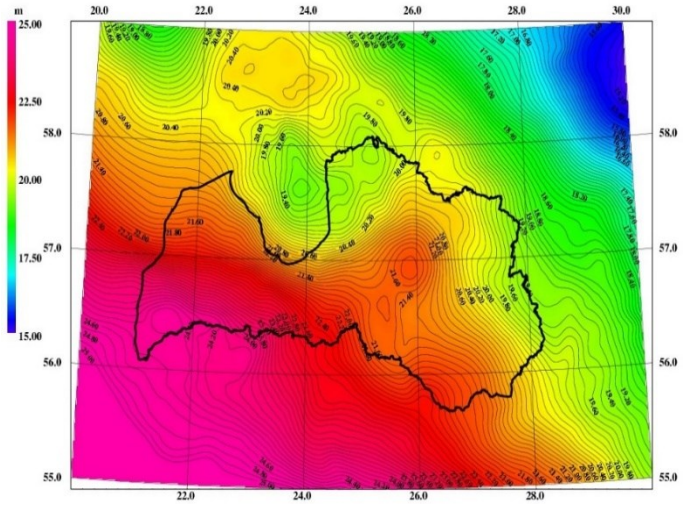


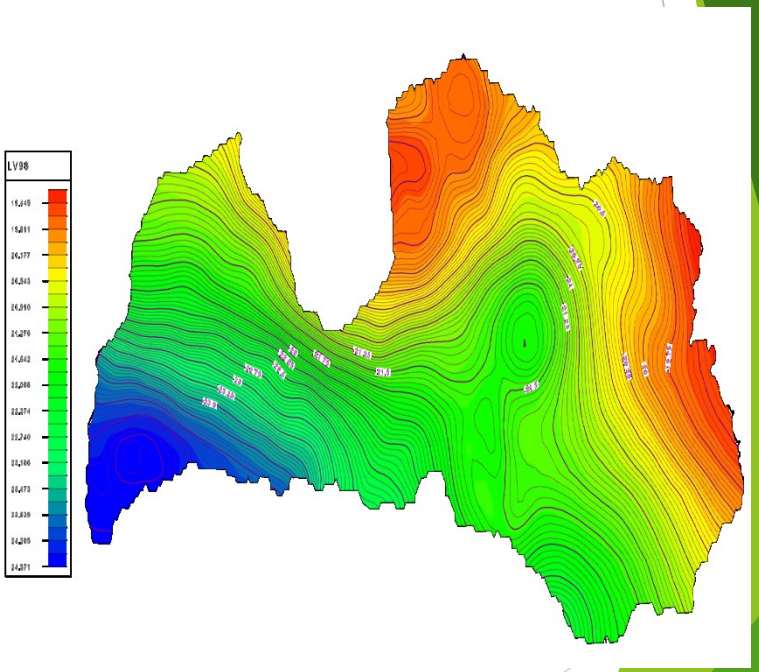
Q-geoid model LV98 of territory of Latvia. Grid interval 0.05 cm



Q-geoid model LV14 of territory of Latvia. Grid interval 0.05 cm. Graphically indicated visually discernible deviation

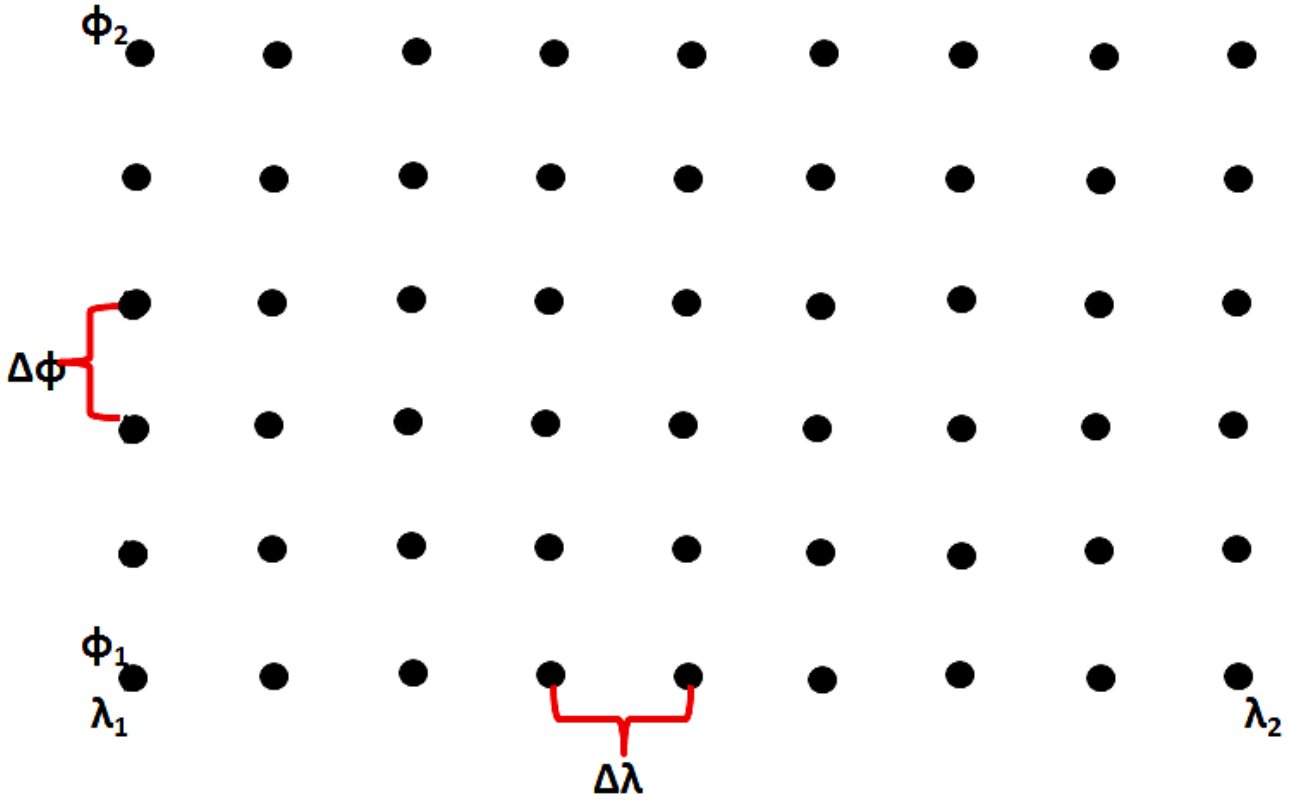
Q - geoid patterns for accuracy researches. Quasi-geoid model LV98





C.I.: 10 cm (~15 m till ~25 m)

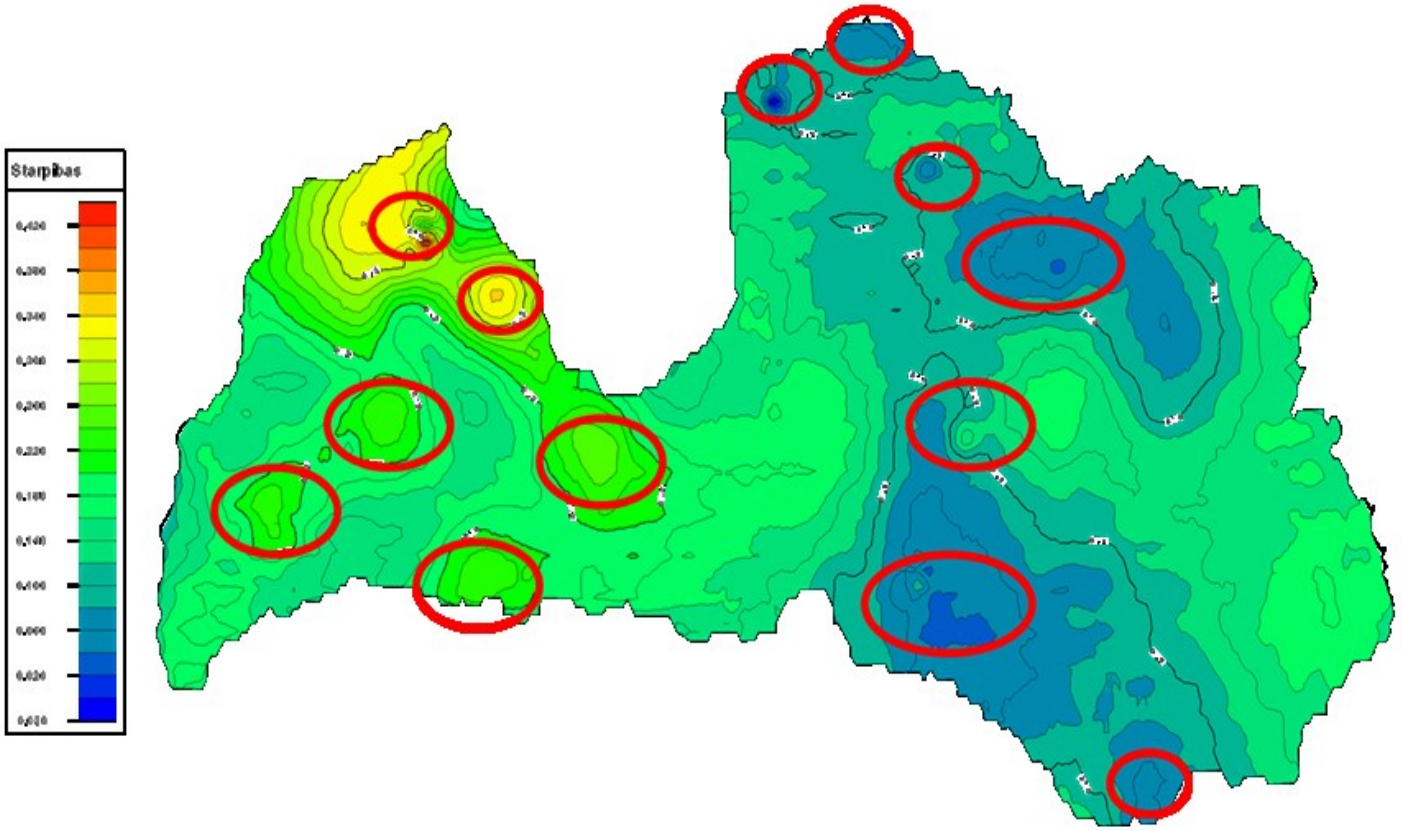
ASCII structure of LV98 model



LV98 contains 32361 point values formatted according GRAVSOFT standard into given area

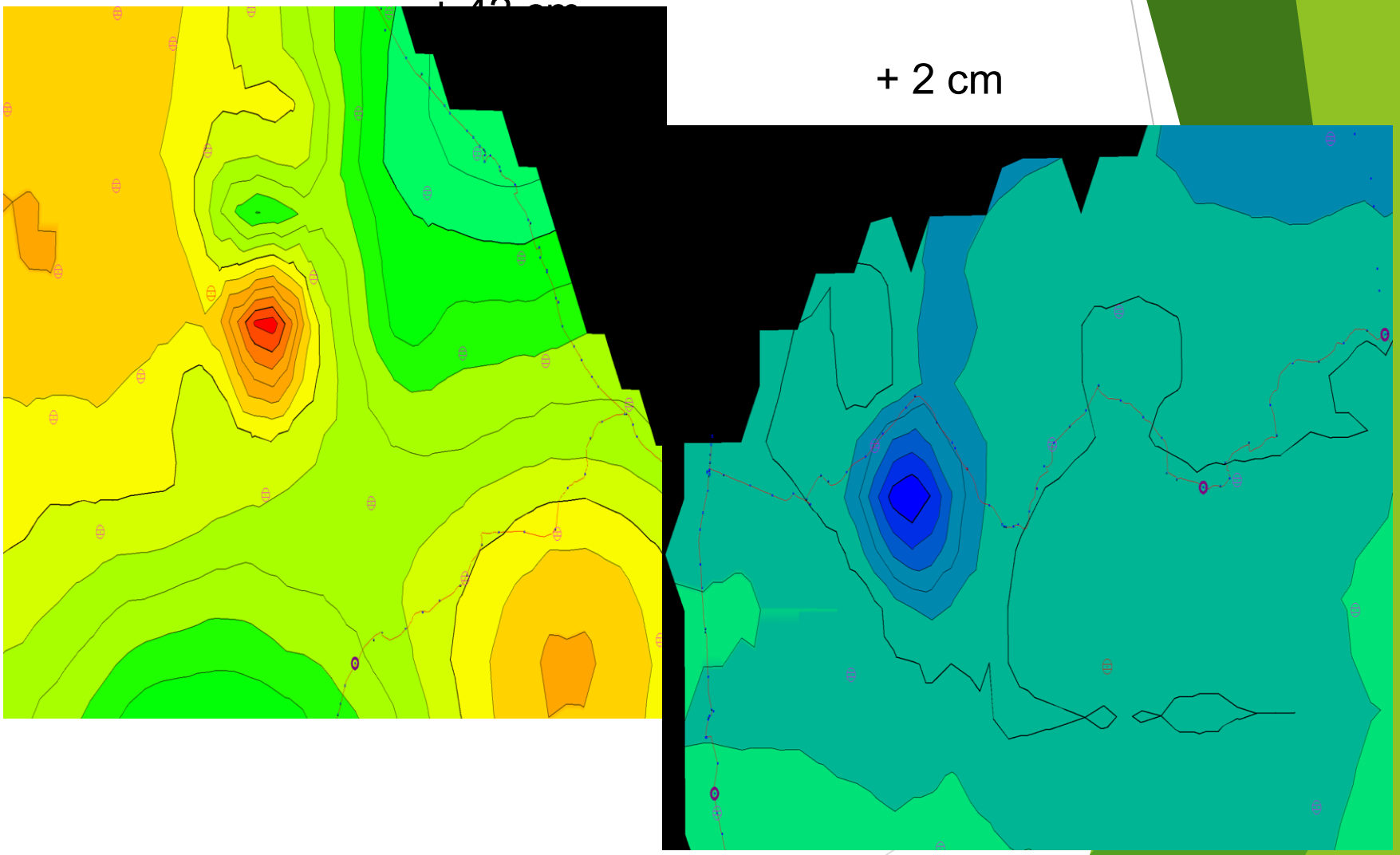
(55.000 59.000 20.000 30.000 0.025 0.050 all in decimal degrees)

Differences between q-geoid model LV98 and LV14 (version 3)

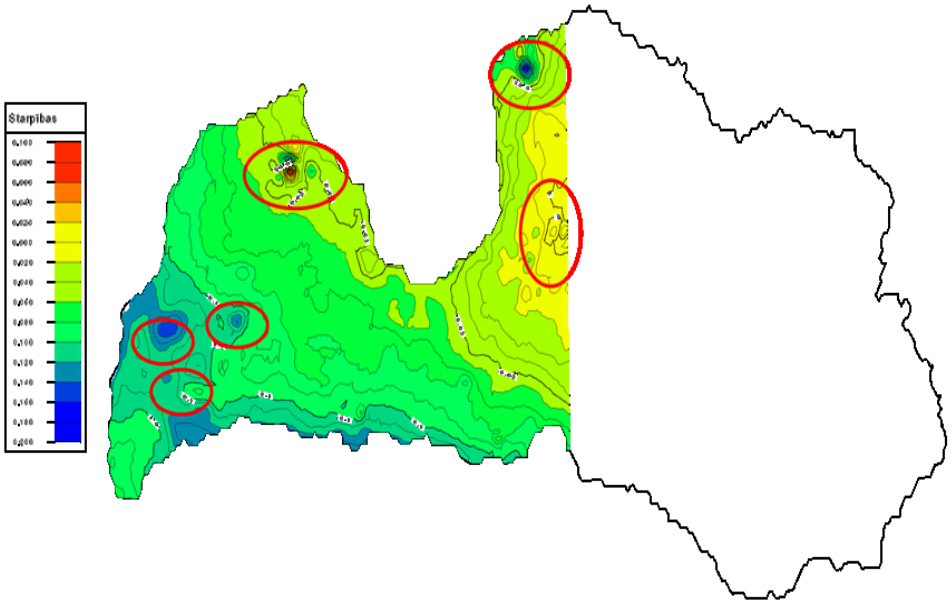


Differences between q-geoid model LV98 and LV14 (version 3) of territory of Latvia. Grid interval 0.01 cm. Graphically indicated visually discernible deviation.

Zooming details of differences

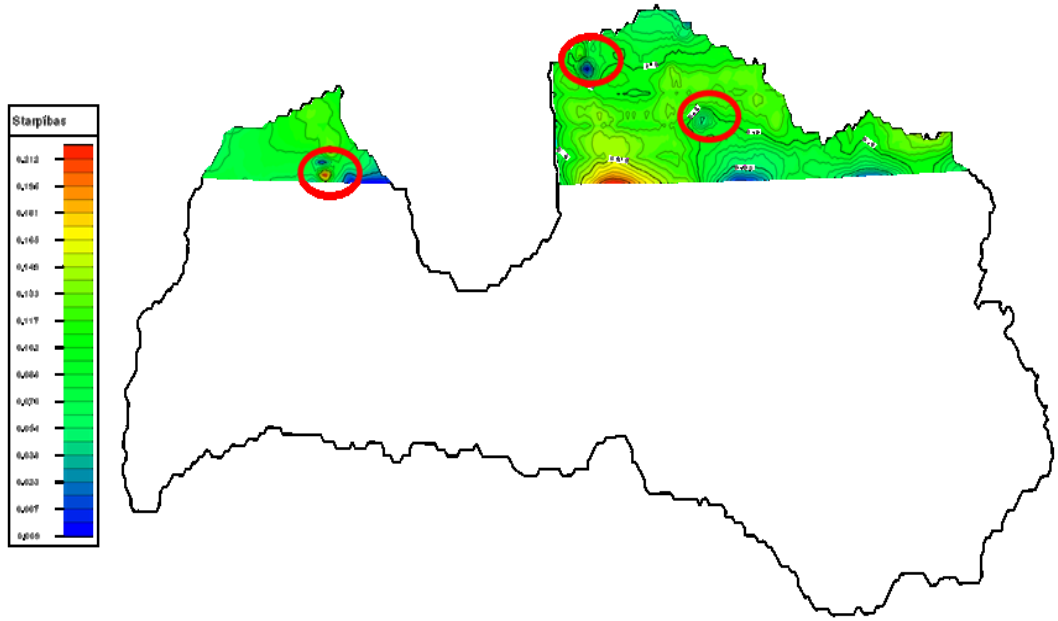


Differences between q-geoid model SWEN08_2000 and LV14 (version 3) of territory of Latvia



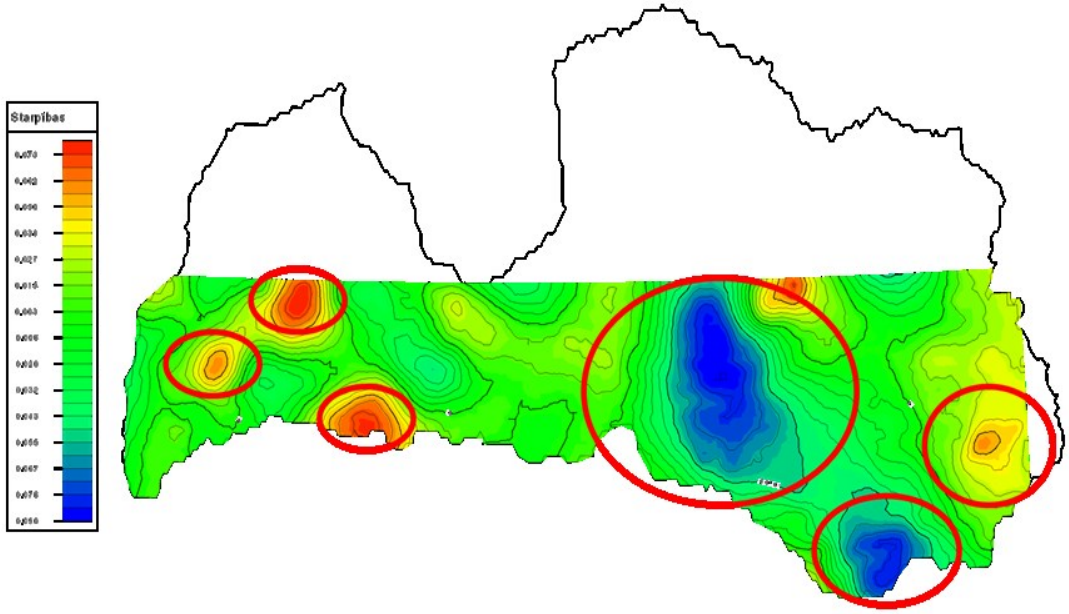
Differences between q-geoid model SWEN08_2000 and LV14 (version 3) of territory of Latvia. Grid interval 0.01 cm Graphically indicated visually discernible deviation

Differences between q-geoid model EST_GEOID2003 and LV14 (version 3) of territory of Latvia



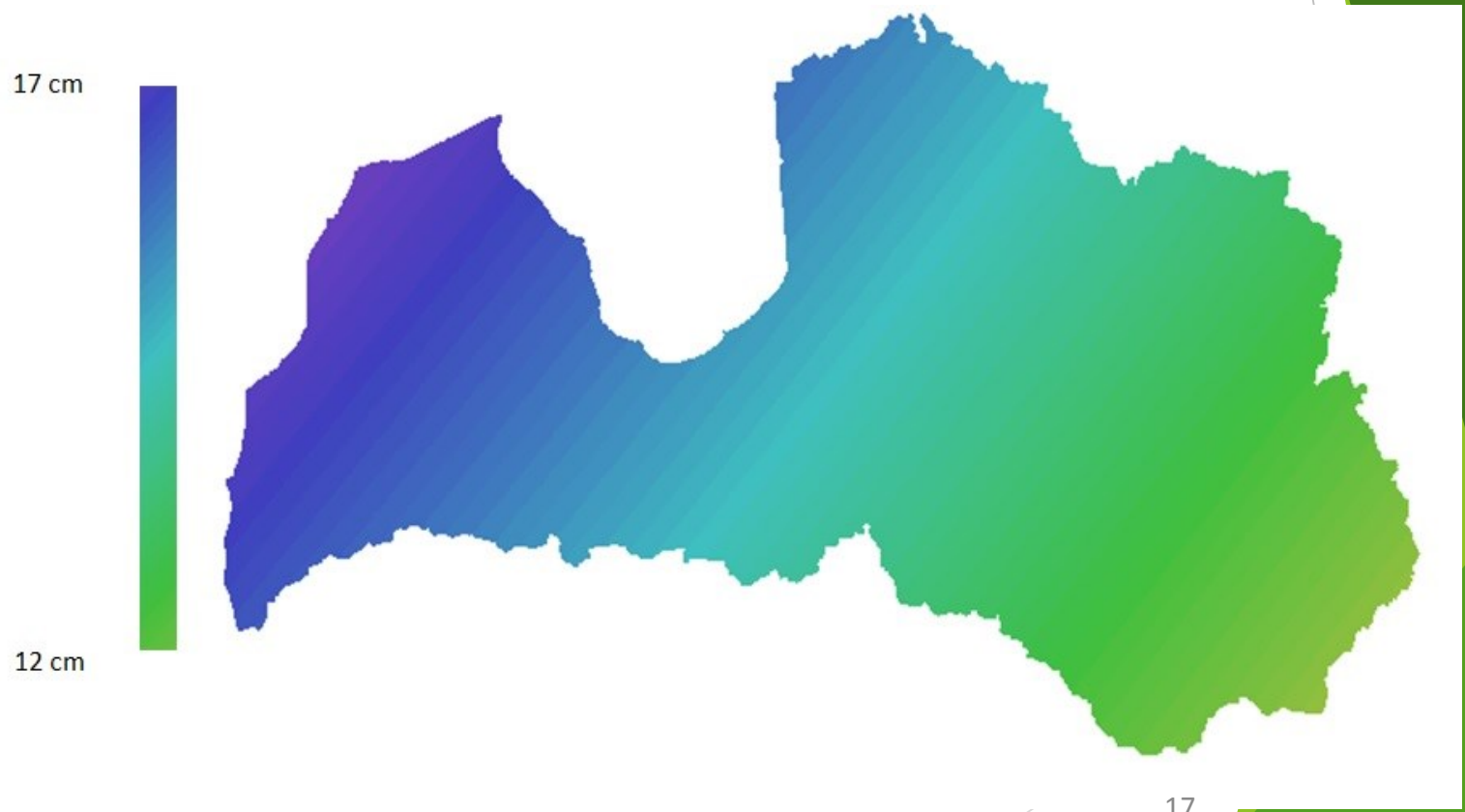
Differences between q-geoid model EST_GEOID2003 and LV14 (version 3) of territory of Latvia. Grid interval 0.01 cm. Graphically indicated visually discernible deviation

Differences between q-geoid model LITH2011 and LV14 (version 3) of territory of Latvia

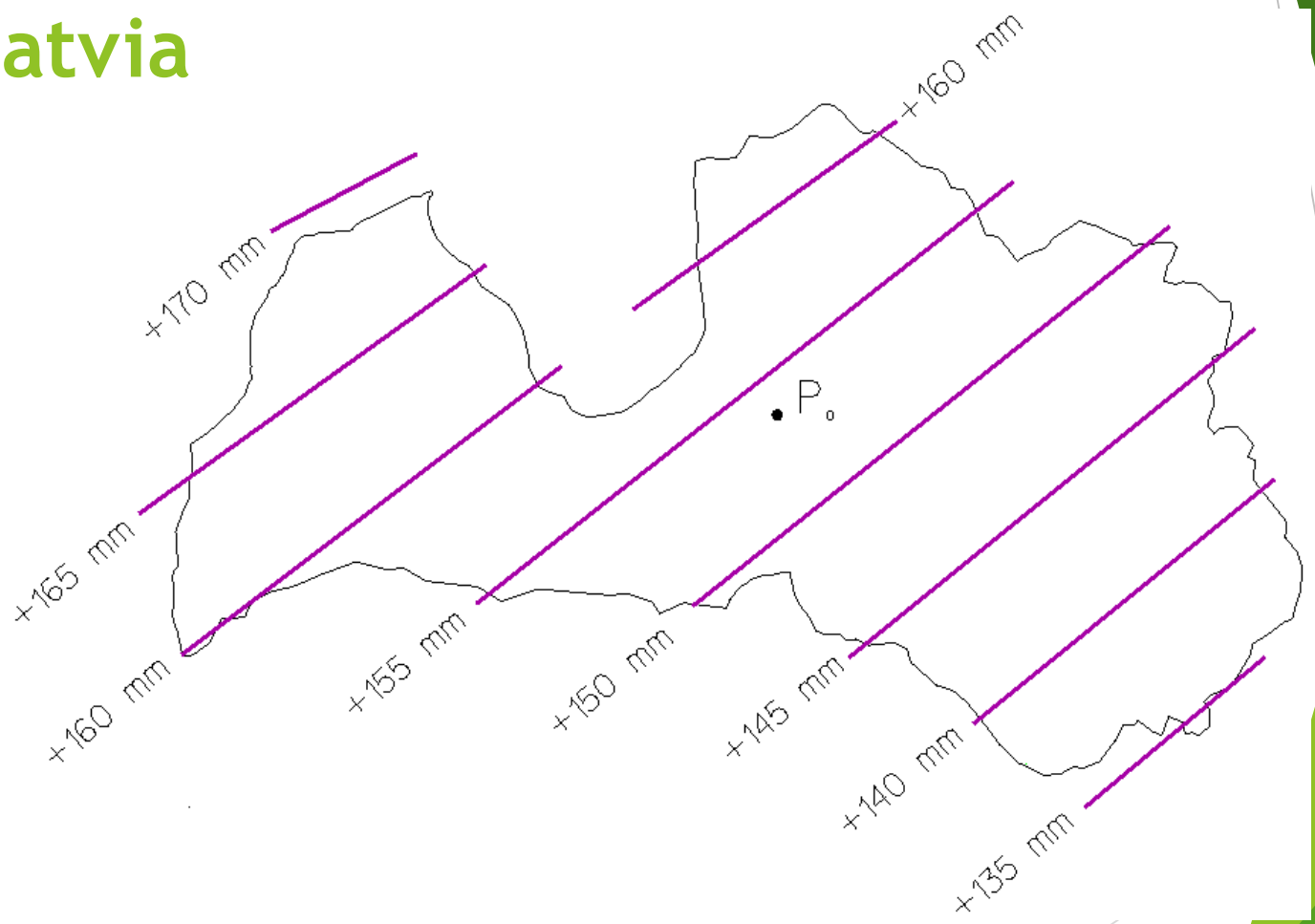


Differences between q-geoid model LITH2011 and LV14 (version 3) of territory of Latvia. Grid interval 0.01 cm. Graphically indicated visually discernible deviation

The transition to the European Vertical Reference System. Data conversion algorithm from BAS-77 to LAS-2000.5



Theoretical differences between BAS-77 and EVRS in territory of Latvia

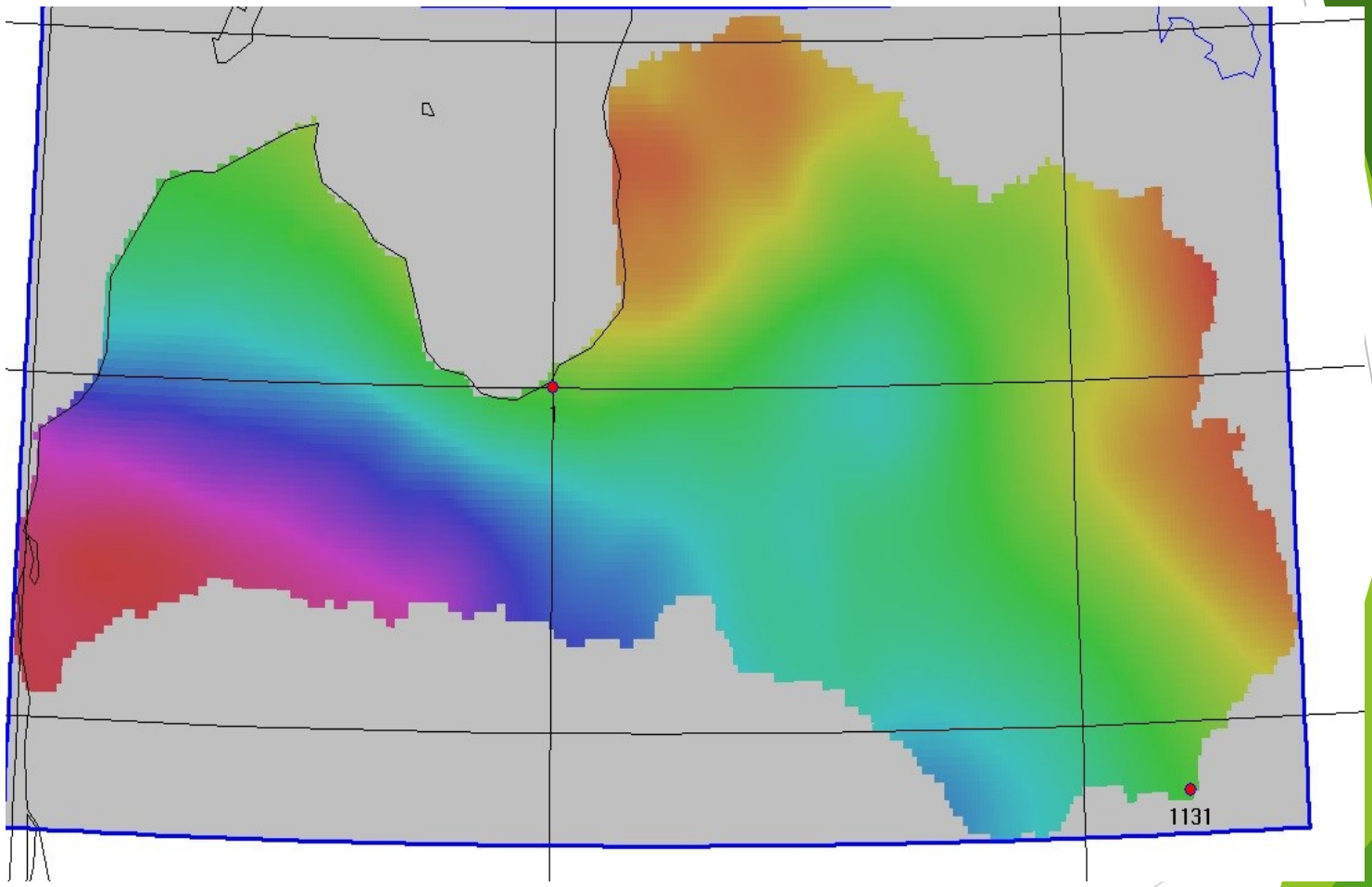


Report: European Vertical Reference System in Baltic Countries; A. Celms, I. Bīmane, I. Reķe «Baltic Surveying'14» Conference in Jelgava, 08.05.2014.

Geodetic network
GPS data (G1, G2)
and
levelling data (N1, N2)
available in state data base:

http://map.lgia.gov.lv/index.php?lang=2lang=0&cPath=2&txt_id=83

LV14 not exists on sea



On sea must use other model, like LV98 or NKG2015

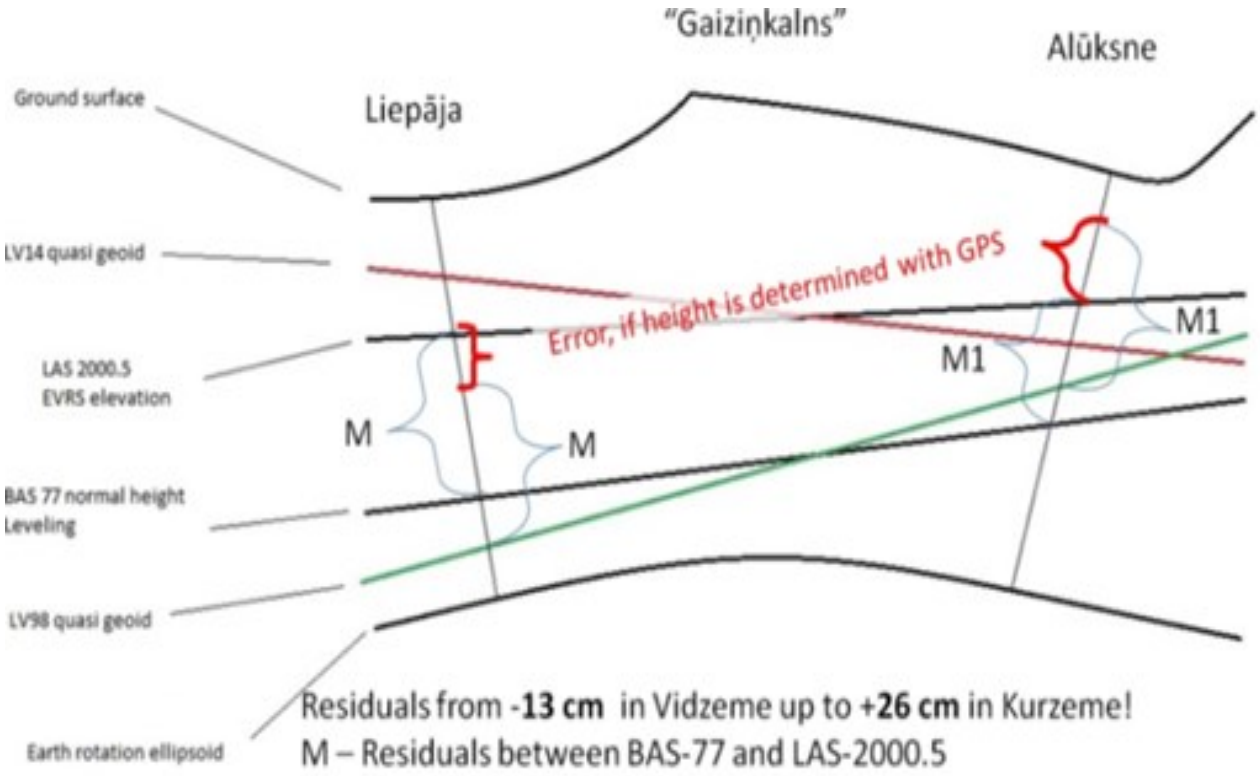
Practical need: ADTI data transformation algorithm (due to change of height system)

It is topographic data in scale 1:500

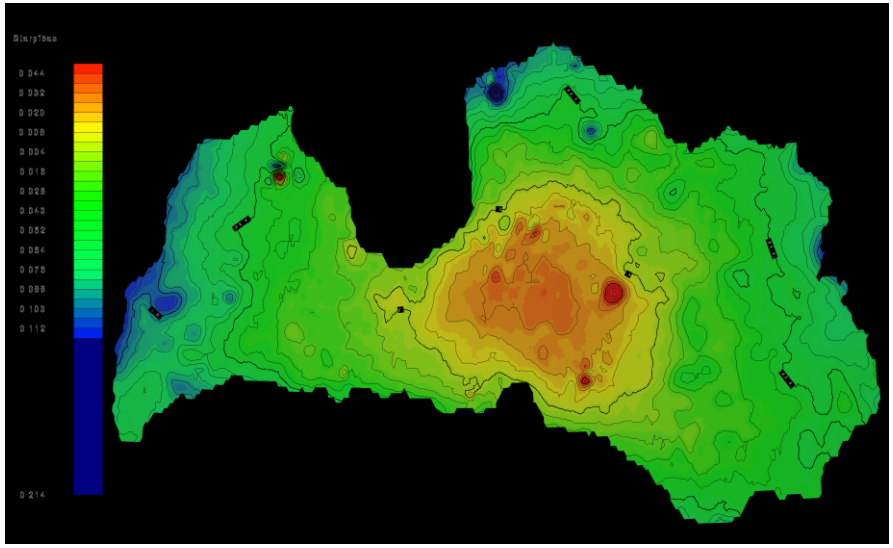
Separate topic, very practical and widely used with surveyors

ADTI = Highly Detailed Topographical Information = HDTI

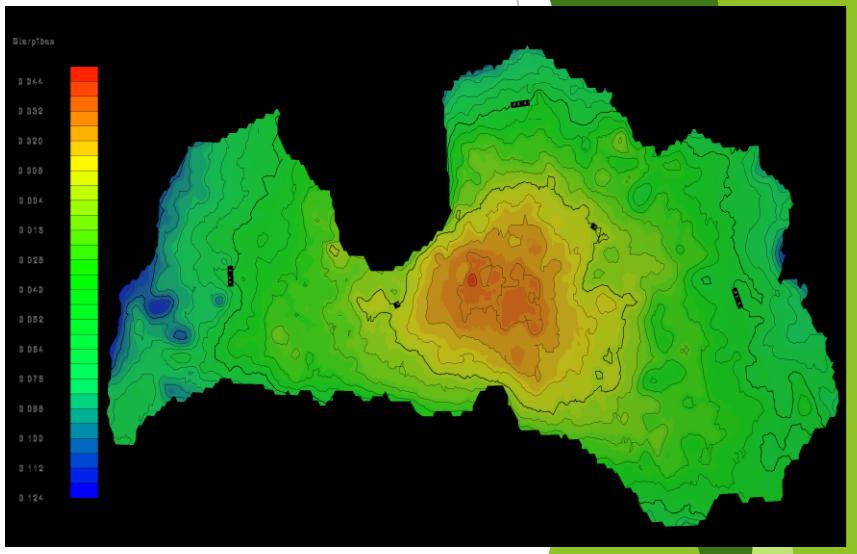
A Highly Detailed Topographical Information data transformation algorithm, contains errors



Differences between q-geoid model EGM 2008, LV14 (version 3) and LV14 (version 4) of territory of Latvia



Differences between q-geoid model EGM-2008 and LV14 (version 3) of territory of Latvia. Grid interval 0.01 cm. Graphically indicated visually discernible deviation



Differences between q-geoid model EGM-2008 and LV14 (version 4) of territory of Latvia. Grid interval 0.01 cm. Graphically indicated visually discernible deviation

Comparison with other gravimetric models in the Nordic/Baltic area

Model	Standard deviation in 1-parameter fit (meter)							
	All	Denmark	Estonia	Finland	Latvia	Lithuania	Norway	Sweden
NKG2015	0.0285	0.0168	0.0147	0.0215	0.0246	0.0333	0.0285	0.0186
NKG1996	0.0907	0.0305	0.0356	0.0737	0.0240	0.0308	0.1078	0.0499
NKG2004	0.0908	0.0274	0.0362	0.0367	0.0782	0.0418	0.0698	0.0431
EGG08	0.0436	0.0198	0.0238	0.0201	0.0336	0.0389	0.0537	0.0253
EGM2008 to 2190	0.0468	0.0227	0.0361	0.0577	0.0285	0.0299	0.0597	0.0287
EIGEN-6C4 to 2190	0.0421	0.0216	0.0341	0.0436	0.0292	0.0366	0.0503	0.0283
EGG2015	0.0351	0.0169	0.0214	0.0209	0.0207	0.0321	0.0412	0.0225

Jonas Ågren, report «Remarks on the released NKG2015 model», NKG WGGHS meeting in Riga 2017-03-16--17

Comparison with other gravimetric models in Latvia

Model	Standard deviation in 1-parameter fit (meter)							
	All	Denmark	Estonia	Finland	Latvia	Lithuania	Norway	Sweden
NKG2015	0.0285	0.0168	0.0147	0.0215	0.0246	0.0333	0.0285	0.0186
NKG1996	0.0907	0.0305	0.0356	0.0737	0.0240	0.0308	0.1078	0.0499
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EGM2008 to 2190	0.0468	0.0227	0.0361	0.0577	0.0285	0.0299	0.0597	0.0287
EIGEN-6C4 to 2190	0.0421	0.0216	0.0341	0.0436	0.0292	0.0366	0.0503	0.0283
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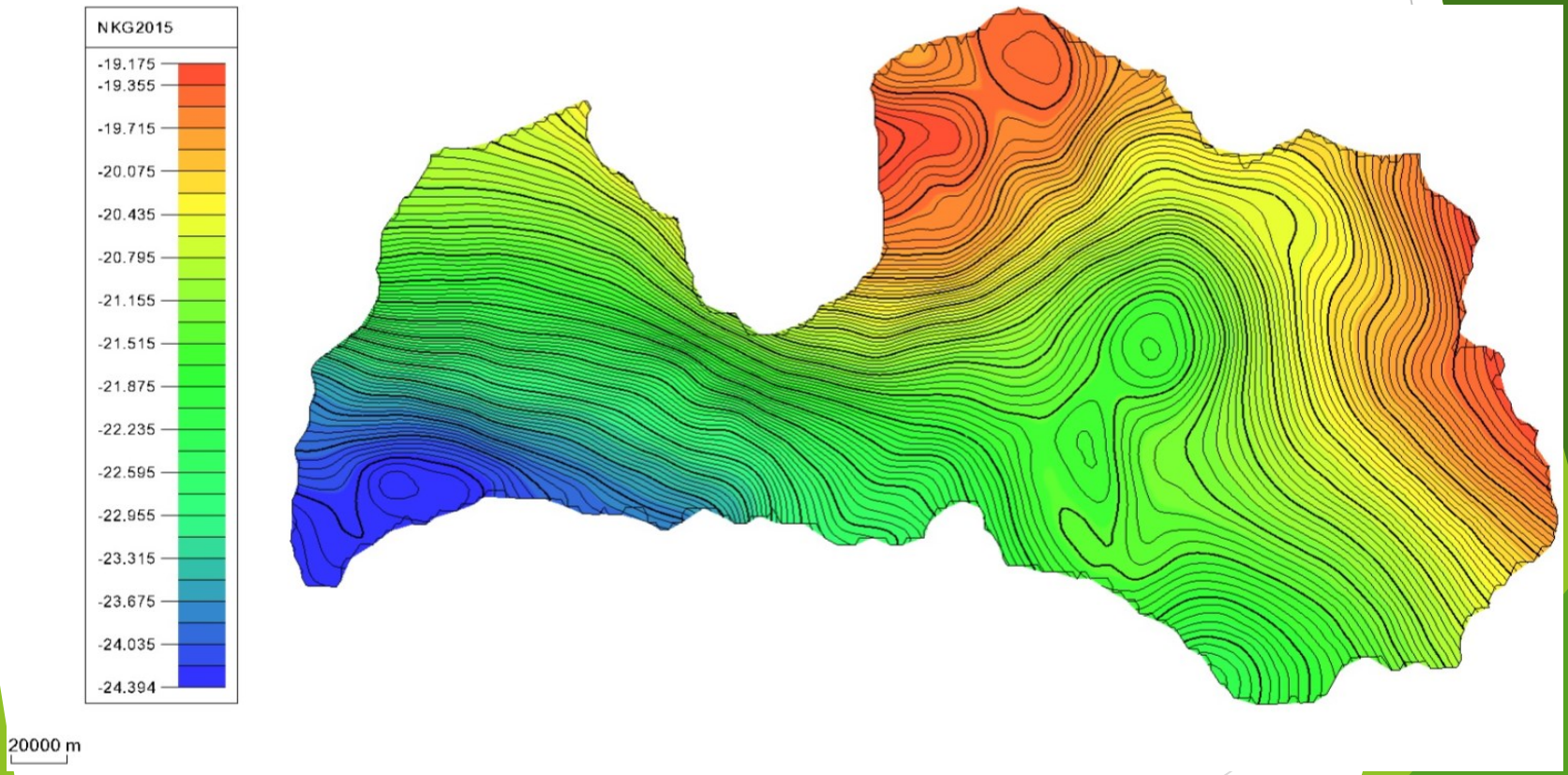
Jonas Ågren, report «Remarks on the released NKG2015 model», NKG WGGHS meeting in Riga 2017-03-16--17

Newly released NKG2015 of territory of Latvia



* without local peaks

Conclusions (I)

- Transformation algorithm used for high detailed topographic information or ADTI data elevation conversion does not respect main surfaces used for elevation data generation *(previous times)*.
- Evaluating gravimetric anomalies defined in the report of LGIA on 14th of November 2014 and comparing them with the Estonian report in NKG Assembly 2014 "Investigations towards the NKG2014 geoid model in Estonia" which authors were Silja Märdla, Tõnis Oja, Artu Ellmann, it is visible that latest Q-geoid model LV14 contains or includes coarse gravimetric errors.
- After transition to EVRS national legislation will still exist in practice both elevation reference surfaces – q-geoid **LV98** (BAS-77/Kronstadt at Baltic) and q-geoid **LV14** (LAS2000.5/Amsterdam at North), both still with no correct transition algorithm for practitioners. Authors of the research conclude that transition to EVRS is done isolated from real needs and technically poorly prepared.

Conclusions (II)

- 4th version of LV14 Q-geoid model is consistent with EVRS in limit up to 16 cm and raise doubts about the effectiveness of elevation reference system transition.
- Due to the implementation of new height reference system (LAS-200.5) also value for the highest Latvian mountain “Gaiziņkalns” considerably grow in a conversion at the time.
- NKG2015 does not show any local peaks.
- In future investigation we involve digital zenith camera for direct determination of the DoV and compare with DoV from q-geoid models (by GRAVSOFT).

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Thank You for your attention !

Questions???

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155